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COST/SCHEDULE RISK ANALYSIS OF ENGINEERING DEVELOPMENT PHASE FO--ETC(U)
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COST/SCHEDULE RISK ANALYSIS OF ENGINEERING DEVELOPMENT PHASE FOR ARMY USER EQUIPMENT OF GPS

April 1977

Prepared for

SPACE AND MISSILE SYSTEMS ORGANIZATION
Los Angeles, California

Under Contract F04701-76-C-0028

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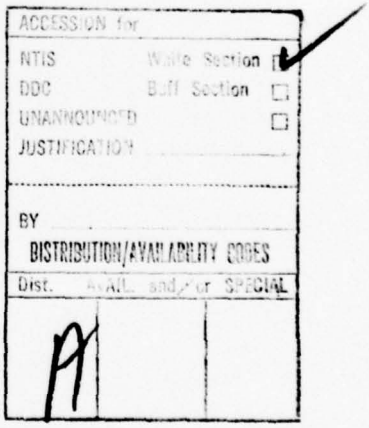
FOREWORD

This report was prepared by ARINC Research Corporation in support of Army evaluations and analyses of user equipment of the NAVSTAR Global Positioning System (GPS). Contained herein is a cost/schedule risk analysis for the Engineering Development Phase (II) of GPS Army user equipment.

The report was prepared as a task under Contract F04701-76-C-0028, issued through the GPS Joint Program Office, U.S. Air Force Space and Missile Systems Organization (SAMSO), Los Angeles, California.



CONTENTS

1. INTRODUCTION

1.1 ANALYSIS CONCEPT

This report describes a cost/schedule risk analysis of the Phase II Army user equipment (UE) development program for the NAVSTAR Global Positioning System. A technical risk analysis is also being conducted under the same contract, results of which will be presented in a future report.

At the direction of the Army, emphasis is being given to the technical-risk portion of the contracted effort. Consequently, the cost/schedule risk analysis has been conducted as a relatively straightforward statistical treatment of existing Army planning data for Phase II of GPS. To the information in those plans were added some top-level Phase II planning data from the GPS Joint Program Office. Finally, certain assumptions and ground rules relating to cost-variation estimating were applied in preparing the statistical inputs to the analysis, as will be explained in this report.

1.2 GPS EQUIPMENT

The NAVSTAR GPS is a space-based radio navigation system that will permit users to determine accurately their three-dimensional position and velocity in real time. The GPS will consist of a space segment (satellites), control segment (ground monitors and control stations), and user segment (manpack, vehicular, airborne, and shipborne navigation sets).

At the time this analysis was conducted, the GPS UE types were designated as classes A, B, C, D, E, F, and M, each class representing a set of performance characteristics suited to particular applications. The sets of interest for Army applications were:

- Class B – High accuracy, high dynamics of user, and medium immunity to jamming. This class of UE was to be integrated into Army helicopters and fixed wing aircraft.
- Class D – High accuracy, low dynamics of user, and high immunity to jamming. This class of UE was to be integrated into Army wheeled vehicles, tracked land vehicles, and riverine craft.

- Class E — High accuracy, low dynamics of user, high immunity to jamming, low weight, small size, and low power consumption. This class of UE was to be used as a personnel backpack (manpack).

Since the completion of the statistical analysis, however, it has become evident that the number of GPS UE classes will be reduced, with combinations of some characteristics from several classes forming the characteristics of a new UE designation. One likely combination is that of the D and E classes into a dual-purpose manpack/vehicular set. It is currently considered possible, however, that the space and environmental constraints in tracked vehicles may require a separate operational set design. To represent the possible parallel development of a manpack/vehicular and a tracked vehicle set, the UE class designations D and E, as used in the Army planning document, have been retained in this report.

The GPS program is currently in Concept Validation (Phase I), which will terminate with the Defense System Acquisition Review Council (DSARC) II review. At the time this analysis was performed, DSARC II was scheduled for March 1978. GPS Phase II, System Test and Limited Capability, extends from DSARC II until December 1981, terminating with DSARC III. A concept of dual contracting for the UE, started in Phase I, will continue during Phase II. This cost/schedule risk analysis reflects the costs of dual contracting.

Phase II will consist of operational testing and establishment of a worldwide limited operational capability. During that phase, the Army budgetary plans used for this analysis call for procurement of eight class B sets, 16 class D sets, and eight class E manpacks. The class B sets will be integrated into Army helicopters. Eight of the class D sets will be installed in wheeled vehicles, four in tracked vehicles, and four in riverine craft.

If the wheeled vehicle and manpack sets are combined into a single design, it is assumed that the eight sets for tracked vehicle and riverine use would still be procured and installed. In addition, 16 manpack/vehicular sets would be procured, with eight of them being mounted on wheeled vehicles. Therefore the types and numbers of installations would remain the same. Further, since the Phase II prototype manufacturing costs of the class D and E sets are estimated to be equal, little or no cost impact would be expected due to the change in set procurements.

2. RISK ANALYSIS

2.1 METHODOLOGY/DATA SOURCES

The network analysis program "Advanced SOLVNET" was selected as the vehicle for performing the cost analysis of the Army UE Phase II effort. A complete description of that analysis program can be found in the Army publication, Advanced SOLVNET, A Network Analyzer Program, Report No. PAPAS-14, Revision 2, February 1975, published by the Systems Analysis Division, Plans Office, Picatinney Arsenal, Dover, New Jersey.

The PERT-type network used in the application of SOLVNET was constructed from the most recent data available pertinent to Phase II scheduling. This consisted of Phase II scheduling information obtained from the JPO at SAMSO; and the NAVSTAR GPS Baseline Cost Estimate, Vols I and II, dated August 1976, prepared by the U.S. Army Satellite Communications Agency. The network is presented in Figure 1.

2.2 DESCRIPTION OF SOLVNET

SOLVNET networks consist of (1) arcs, representing activities, and (2) nodes, representing the events (milestones) and logic of the project activity sequence. Characteristics of these network elements are described in the following paragraphs.

2.2.1 Arcs

SOLVNET arcs are characterized by:

a. The arc name, a brief descriptor of the activity occurring between two nodes or milestones. The SOLVNET program requires, for input to the computer, that each arc be given four or fewer alphanumeric characters. In this analysis, the first letter of the arc is usually that of the equipment class (B, D, or E).

b. The names of the initiating and terminating nodes of the arc. Four alphanumeric characters are used to identify each node. Again, in general, the first letter of the node name identifies the equipment class.

c. The probability of successfully completing the arc once it has been initiated. In this analysis, a probability of 1.0 was assigned to all arcs except those

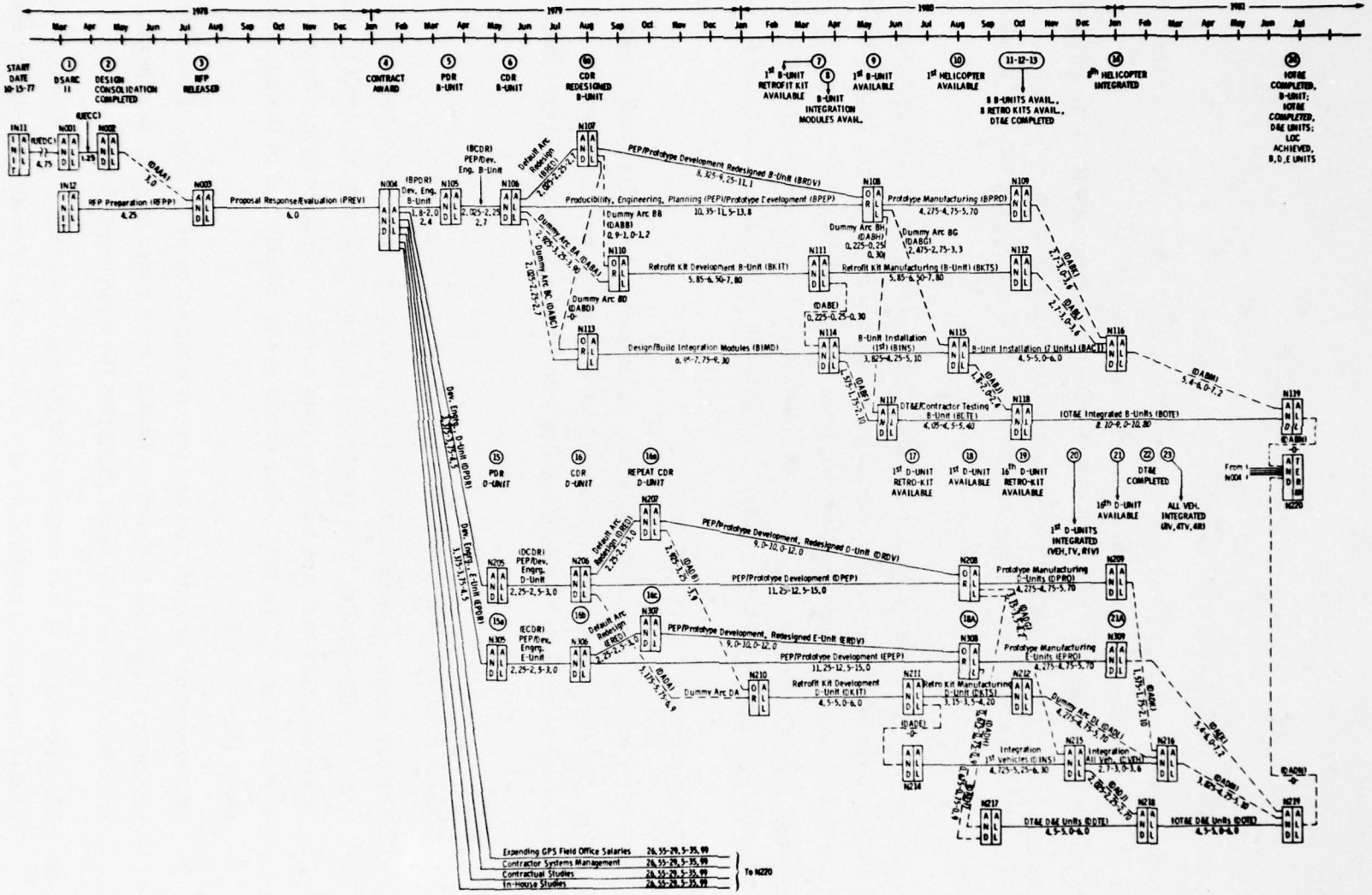


Figure 1. Army GPS Phase II Planning Network

terminating in a Critical Design Review (CDR) for the respective class of equipment. For example, referring to Figure 1, arcs BCDR and DCDR were assigned (subjectively) a probability of 0.9, and ECDR was assigned 0.8. Section 2.2.2.2 discusses the initiation of "default arcs" upon failure to complete CDR-related arcs.

d. The fixed and linear (with respect to time) costs associated with the activity represented by the arc. Table 1 shows the fixed costs assigned to each arc. Superscripts appearing in cost information refer to notes in Table 2, where the derivation of indicated costs is explained.

e. Distribution of completion times. For this analysis, triangularly distributed times were used, with the points of the triangle defined as "shortest time" (argument 1, or ARG-1), "most likely time" (ARG-2), and "longest time" (ARG-3). These times are indicated in months on each arc in Figure 1.

f. An indicator to show if the time and cost of an activity are dependent on when the terminal node of the activity is satisfied. In SOLVNET, an activity time is not necessarily the time between nodes. In this analysis, arc completion time is limited to being not later than the time that its output node is satisfied.

g. An indicator to show if the arc time is time- and/or probability-dependent on other arcs or nodes. In this analysis, all arcs were assumed to be probability-independent of other arcs and nodes.

2.2.2 Nodes

SOLVNET nodes consist of input and output rules, as defined below. When the proper input rule conditions are realized, the node is said to be satisfied and its output arcs are initiated according to its output rule.

2.2.2.1 Node Input Rules

Nodes have three basic input rules:

a. An INITIAL node possesses no input arcs and is used for the starting point(s) of the network. In this analysis, two initial nodes were used and appear in Figure 1 as IN11 and IN12.

b. An AND input rule requires that all arcs entering the node be successfully completed before the node is satisfied and its output arcs initiated.

TABLE 1. GPS COST ALLOCATION (Sheet 1 of 2)

Item	Activity	Calendar Time		Milestone (See Fig. 1)	Arc Name	Node		Duration, Months			Cost (FY75 $)*		
		From	To			Input	Output	ARG-1	ARG-2	ARG-3	Fixed	Incremental	Incremental, ARG-2
1	UE Design Consolidation	10-15-77	3-7-78	(1) DSARC II (Phase II Approval)	UEDC	IN11	N001	4.75	4.75	4.75	0	0	0^{1}*
2	Design Consolidation Continued	3-7-78	4-15-78	(2) Design Consolidation Completed	UECC	N001	N002	1.25	1.25	1.25	0	0	0^{1}
3	RFP Preparation	3-7-78	7-15-78	(3) RFP Released	RFPP	IN12	N003	4.25	4.25	4.25	0	0	0^{2}
4	Dummy Arc AA	4-15-78	7-15-78	—	DAAA	N002	N003	3.00	3.00	3.00	0	0	0^{3}
5	Proposal Response/Evaluation	7-15-78	1-15-79	(4) Contract Award (Dual)	PREV	N003	N004	6.00	6.00	6.00	0	0	0^{2}
6	Development Engrg., B-Unit	1-15-79	3-15-79	(5) Preliminary Design Review, B-Unit	BPDR	N004	N105	1.8	2.00	2.40	0	0	0^{4}
7	PEP/Dev. Engrg., B-Unit	3-15-79	5-21-79	(6) Critical Design Review	BCDR	N105	N106	2.025	2.25	2.70	0	$27,907^{5}$*	62,790
8	PEP/Prototype Development	5-21-79	5-7-80	(9) 1st B-Unit Available	BPEP	N106	N108	10.35	11.5	13.80	$50,000^{6}$*	$27,907^{5}$	320,930
9	Prototype Manufacturing	5-7-80	10-1-80	(11) 8th B-Unit Available	BPRO	N108	N109	4.275	4.75	5.7	$350,000^{6}$	$27,907^{5}$	216,280
10	Default Arc, Redesign	5-21-79	8-1-79	(6a) Repeat CDR	BRED	N106	N107	2.025	2.25	2.70	0	$41,860^{7}$	(94,186)**
11	Prototype Dev., Redesigned Unit	8-1-79	5-7-80	(9) 1st B-Unit Available	BRDV	N107	N108	8.325	9.25	11.10	$(50,000)^{6}$	$41,860^{7}$	(387,209)
12	Dummy Arc, BA	5-21-79	9-1-79	—	DABA	N106	N110	2.925	3.25	3.90	0	0	0^{3}
13	Retrofit Kit Development, B-Unit	9-1-79	3-15-80	(7) 1st B-Unit Retro-Kit Available	BKIT	N110	N111	5.85	6.5	7.80	$12,500^{8}$	$30,769^{9}$	200,000
14	Retrofit Kit Manufacture, B-Unit	3-15-80	10-1-80	(12) 8th B-Unit Retro-Kit Available	BKTS	N111	N112	5.85	6.5	7.80	$87,500^{8}$	$30,769^{9}$	200,000
15	Dummy Arc, BB	8-1-79	9-1-79	—	DABB	N107	N110	0.9	1.0	1.20	0	0	0^{3}
16	Dummy Arc, BC	5-21-79	8-1-79	—	DABC	N106	N113	2.025	2.25	2.7	0	0	0^{3}
17	Design Build Integr. Modules	8-1-79	3-21-80	(8) Integration Modules Available	BIMD	N113	N114	6.975	7.75	9.30	0	0	0^{10}
18	B-Unit Installation, 1st Unit	3-21-80	8-1-80	(10) 1st Helicopter Integrated	BINS	N114	N115	3.825	4.25	5.10	$11,000^{11}$	0^{12}	0^{12}
19	B-Unit Installation, 7 Units	8-1-80	1-1-81	(14) 8th Helicopter Integrated	BACI	N115	N116	1.50	5.0	6.0	$77,000^{11}$	0^{12}	0^{12}
20	Dummy Arc, BD	8-1-79	8-1-79	—	DABD	N107	N113	0	0	0	0	0	0^{3}
21	Dummy Arc, BE	3-15-80	3-21-80	—	DABE	N111	N114	0.225	0.25	0.30	0	0	0^{3}
22	Dummy Arc, BF	3-21-80	5-15-80	—	DABF	N114	N117	1.575	1.75	2.10	0	0	0^{3}
23	Dummy Arc, BG	5-7-80	8-1-80	—	DABG	N108	N115	2.475	2.75	3.3	0	0	0^{3}
24	Dummy Arc, BH	5-7-80	5-15-80	—	DABH	N108	N117	0.225	0.25	0.30	0	0	0^{3}
25	DT&E Contractor Testing	5-15-80	10-1-80	(13) DT&E Completed	BDTE	N117	N118	4.05	4.5	5.40	$1,200,000^{13}$	0^{15}	0^{15}
26	IOT&E	10-1-80	7-1-81	(24a) IOT&E Completed	BOTE	N118	N119	8.10	9.0	10.80	$500,000^{14}$	0^{15}	0^{15}
27	Dummy Arc, BJ	8-1-80	10-1-80	—	DABJ	N115	N118	1.8	2.0	2.4	0	0	0^{3}
28	Dummy Arc, BK	10-1-80	1-1-81	—	DABK	N109	N116	2.7	3.0	3.6	0	0	0^{3}
29	Dummy Arc, BL	10-1-80	1-1-81	—	DABL	N112	N116	2.7	3.0	3.6	0	0	0^{3}
30	Dummy Arc, BM	1-1-81	7-1-81	—	DABM	N116	N119	5.4	6.0	7.2	0	0	0^{3}
31	Dummy Arc, BN	7-1-81	7-1-81	(24) B-Unit LOC	DABN	N119	N220	0	0	0	0	0	0^{3}
32	Dev. Engrg., D-Unit	1-15-79	5-7-79	(15) Preliminary Design Review, D-Unit	DPDR	N004	N205	3.375	3.75	4.5	0	$208,000^{16}$	780,000

*See Table 2 for notes on cost information. **Figures appearing in parentheses are not included in the totals at the end of the columns on sheet 2.

TABLE 1. (Sheet 2 of 2)

Item	Activity	Calendar Time		Milestone (See Fig. 1)	Arc Name	Node		Duration, Months			Cost (FY75 $)*		
		From	To			Input	Output	ARG-1	ARG-2	ARG-3	Fixed	Incremental	Incremental, ARG-2
33	PEP Dev. Engr., D-Unit	5-7-79	7-21-79	(16) Critical Design Review, D-Unit	DCDR	N205	N206	2.25	2.5	3.00	0	258,633[16]	646,583
34	Default Arc, Redesign D-Unit	7-21-79	10-7-79	(16a) Repeat CDR, D-Unit	DRED	N206	N207	2.25	2.5	3.00	0	387,950[17]	(969,874)
35	Prototype Dev., Redesigned D-Unit	10-7-79	8-7-80	(18) 1st D-Unit Available	DRDV	N207	N208	9.00	10.0	12.00	(42,000)[19]	387,950[17]	(3,879,500)
36	PEP Prototype Development	7-21-79	8-7-80	(18) 1st D-Unit Available	DPEP	N206	N208	11.25	12.5	15.0	42,000[19]	258,633[16]	3,232,913
37	Prototype Manufacturing, D-Unit	8-7-80	1-1-81	(21) 16th D-Unit Available	DPRO	N208	N209	4.275	4.75	5.70	630,000[19]	50,633[16]	240,507
38	Retrofit Kit Development, D-Unit	1-15-80	6-15-80	(17) 1st 3 D-Unit Retro-Kits Available	DKIT	N210	N211	4.50	5.0	6.00	56,250[18]	141,176[18]	705,882
39	Retrofit Kit Manufacturing, D-Unit	6-15-80	10-1-80	(19) 16th D-Unit Retro-Kit Available	DKTS	N211	N212	3.15	3.5	4.20	243,750[18]	141,176[18]	494,118
40	Integration 1st Vehicles	6-15-80	11-21-80	(20) 1st Veh., Track Veh., Riverine Veh. Int.	DINS	N214	N215	4.725	5.25	6.30	0	0[20]	0
41	Integration All Vehicles	11-21-80	2-21-81	(23) 8th Veh., 4th Track Veh., 4th Riv. Veh. Int.	DVEH	N215	N216	2.70	3.00	3.60	0	0[20]	0
42	DT&E Contractor Testing, D&E Units	9-1-80	2-1-81	(22) DT&E Completed, D&E Units	DDTE	N217	N218	4.50	5.0	6.00	3,000,000[21]	0[15]	0
43	IOT&E	2-1-81	7-1-81	(24) IOT&E Completed, D&E Units	DOTE	N218	N219	4.50	5.0	6.00	1,500,000[14]	0[15]	0
44	Dev. Engr., E-Unit	1-15-79	5-7-79	(15a) Preliminary Design Review, E-Unit	EPDR	N004	N305	3.375	3.75	4.5	0	312,000[16]	1,170,000
45	PEP Dev. Engr., E-Unit	5-7-79	7-21-79	(16b) Critical Design Review, E-Unit	ECDR	N305	N306	2.25	2.5	3.00	0	362,633[16]	906,583
46	Default Arc, Redesign E-Unit	7-21-79	10-7-79	(16c) *Repeat CDR, E-Unit*	ERED	N306	N307	2.25	2.5	3.00	0	543,950[17]	(1,359,874)
47	Prototype Dev., Redesigned E-Unit	10-7-79	8-7-80	(18a) 1st E-Unit Available	ERDV	N307	N308	9.0	10.0	12.00	(42,000)[19]	543,950[17]	(5,439,950)
48	PEP Prototype Development	7-21-79	8-7-80	(18a) 1st E-Unit Available	EPEP	N306	N308	11.25	12.5	15.0	42,000[19]	362,633[16]	4,532,913
49	Prototype Manufacturing, E-Unit	8-7-80	1-1-81	(21a) 8th E-Unit Available	EPRO	N308	N309	4.275	4.75	5.70	294,000[19]	50,633[16]	240,507
50	Dummy Arc, DA	7-21-79	1-15-80	—	DADA	N206	N210	5.175	5.75	6.90	0	0	0
51	Dummy Arc, DB	10-7-79	1-15-80	—	DADB	N207	N210	2.925	3.25	3.90	0	0	0
52	Dummy Arc, DE	6-15-80	6-15-80	—	DADE	N211	N214	0	0	0	0	0	0
53	Dummy Arc, DG	8-7-80	11-21-80	—	DADG	N208	N215	3.15	3.5	4.20	0	0	0
54	Dummy Arc, DH	8-7-80	9-1-80	—	DADH	N208	N217	0.675	0.75	0.90	0	0	0
55	Dummy Arc, EH	8-7-80	9-1-80	—	DAEH	N308	N217	0.675	0.75	0.90	0	0	0
56	Dummy Arc, DJ	11-21-80	2-1-81	—	DADJ	N215	N218	2.025	2.25	2.70	0	0	0
57	Dummy Arc, DK	1-1-81	2-21-81	—	DADK	N209	N216	1.575	1.75	2.10	0	0	0
58	Dummy Arc, DL	10-1-80	2-21-81	—	DADL	N212	N216	4.275	4.75	5.70	0	0	0
59	Dummy Arc, EK	1-1-81	7-1-81	—	DAEK	N309	N219	5.40	6.0	7.20	0	0	0
60	Dummy Arc, DM	2-21-81	7-1-81	—	DADM	N216	N219	3.825	4.25	5.10	0	0	0
61	Dummy Arc, DN	7-1-81	7-1-81	(24a) D&E Units LOC	DADN	N219	N220	0	0	0	0	0	0
62	GPS Field Office Salaries	1-15-79	7-1-81	—	FSAL	N004	N220	26.55	29.5	35.99	1,572,500[22]	85,000[22]	2,507,500
63	Contractor Systems Management	1-15-79	7-1-81	—	MGMT	N004	N220	26.55	29.5	35.99	2,091,000[24]	34,746[23]	1,025,000
64	Contractual Studies	1-15-79	7-1-81	Contractual Studies Completed	CSTU	N004	N220	26.55	29.5	35.99	3,146,000[25]	0	0
65	In-House Studies	1-15-79	7-1-81	In-House Studies Completed	ISTU	N004	N220	26.55	29.5	35.99	2,660,000[26]	0	0
											17,565,500		17,482,506

TABLE 2. EXPLANATORY COST INFORMATION FOR TABLE 1 (Sheet 1 of 4)

Note*	Comments
1	Continuation of Phase I activity shown for continuity to Phase II. No Phase II costs associated with this segment.
2	No cost to Army.
3	No associated costs for dummy arcs.
4	Air Force assumes development costs for B-units.
5	Estimated Producibility, Engineering, Planning (PEP) cost for Army B-unit is $600,000. Balance to be incurred by Air Force as agreed to at a joint meeting of tri-service personnel (see BCE**, p. 29). PEP funds are assumed to be expended from the end of PDR (3-15-79) through delivery of the eighth B-unit on 1-1-81 (21.5 months). $600,000/21.5 = $27,907/month.
6	Cost per B-unit is given as $50,000 in BCE Vol. I, p. 30.
7	In the event of CDR failure, it is assumed that a redesign effort will be attempted and will succeed. It is further assumed that an accelerated spending level will ensue to minimize schedule slippage. The accelerated rate is assumed to be 1.5 x $27,907 = $41,860. The accelerated rate will continue through prototype development (first unit available).
8	Retrofit kit costs for 8 B-units as per BCE Vol. I, p. 30. Labor, $400,000; materials, $100,000; first kit = $100,000/8 = $12,500 for materials (fixed cost).
9	Incremental cost (labor) for 8 B-unit retrofits is expended 9-1-79 thru 10-1-80, at an assumed linear rate: $400,000/13 mo. = $30,769/mo.
10	It is assumed that the Air Force will absorb the development cost of the Airborne Integration Module (BCE, Vol. I, p. 29).
11	A cost per module of $6,000 plus $5,000 retrofit is required to make the set operational in an aircraft (BCE Vol. II, p. 4).
12	No additional cost to Army for aircraft integration.
13	Airborne testing as per BCE Vol. I, p. 31 ($1,200,000).

*Numbers pertain to superscripts in Table 1.

**All references to BCE pertain to "NAVSTAR Global Positioning System, Baseline Cost Estimate", Volume I and II, August 1976, U.S. Army Satellite Communications Agency, Fort Monmouth, N.J.

TABLE 2. (Sheet 2 of 4)

Note*	Comments
14	Total cost of in-house IOT&E, as per BCE Vol. I, p. 33, is $2,000,000. ($200K per range use)(10). It is assumed the cost for testing each unit type will be the same, i.e., $2,000,000/32 = $62,500 per set (fixed cost).
15	No additional cost to Army. Any additional costs are assumed absorbed in field salaries.
16	Ref.: BCE Vol. I, para. 1.11, p. 24. The hardware engineering development cost of $9,750,000 is assumed to be for both D and E units, and is divided into 40% for the D-unit and 60% for the E-unit. The latter value is larger due to the added requirement to reduce the size and weight of the manpack (E-unit). This development cost is assumed to be expended from contract award through production of the first D and E units (1-15-79 through 8-7-80, 18.75 months). In addition, PEP funds of $2,000,000 are expended equally between the D and E units commencing with the PDR through delivery of final prototype units (5-7-79 through 1-1-81, 19.75 months). For the D-unit: (a) 40% of $9,750,000 = $3,900,000; $3,900,000/18.75 = $208,000/mo. (b) $1,000,000/19.75 = $50,633/mo. From 1-15-79 to 5-7-79, rate is (a), $208,000/mo. From 5-7-79 to 8-7-80, rate is (a) + (b), $258,633/mo. From 8-7-80 to 1-1-81, rate is (b), $50,633/mo. For the E-unit: (a) 60% of $9,750,000 = $5,850,000; $5,850,000/18.75 = $312,000/mo. (b) $1,000,000/19.75 = $50,633/mo. From 1-15-79 to 5-7-79, rate is (a), $312,000/mo. From 5-7-79 to 8-7-80, rate is (a) + (b), $362,633/mo. From 8-7-80 to 1-1-81, rate is (b), $50,633/mo.
17	Under a redesign effort, i.e., failure to pass CDR, it is assumed that the rate of expenditure will be 1.5 times the normal rate, or $387,950/month for the D-unit and $543,950/month for the E-unit.

TABLE 2. (Sheet 3 of 4)

Note*	Comments
18	Re: BCE Vol. I, p.30, para. 1.13: D-unit retrofit kit development for this segment is for three types of kits: vehicle, track vehicle, and riverine kit. Each type has a $400,000 incremental cost and a $100,000 fixed cost. (3)($400,000) = $1,200,000 total incremental cost (3)($100,000) = $300,000 total fixed cost for 16 units, $300,000/16 = $18,750/unit. Incremental costs are expended from 1-15-80 thru 10-1-80 (8.5 mo.): $1,200,000/8.5 = $141,176/mo.
19	Ref: BCE Vol. I, p. 30, para. 1.14: Prototype manufacturing of manpack; vehicular sets @ $42,000 each.
20	Integration/installation costs are assumed to be absorbed in Field Salaries.
21	System test and evaluation cost for manpack/vehicular units is $3,000,000, per BCE Vol. I, p. 31, and is assumed to be a fixed cost.
22	Ref: BCE Vol I, p. 33, para. 1.263. Estimate of 24 personnel at an average $42,500 p.a. = $1,020,000/yr. $1,020,000/12 = $85,000/mo. This figure is used as the incremental (variable) cost for GPS field salaries over the period 1-15-79 thru 7-1-81 ($2,507,500). Fixed cost is the difference between this total incremental cost of $2,507,000 and total allocated GPS field salaries of $4,080,000, per BCE, p. 33. Since the BCE allocates field salaries for half of 1978 through half of 1982, it is assumed that these salaries will be paid to establish (prior to contract award) and retain (between end of Phase II and start of Phase III) the GPS field offices, and therefore should be reflected in Phase II costs.
23	BCE Vol. I, p. 31, para 1.164: Estimated contractor systems management cost of $1,025,000 is for period from contract award through IOT&E (1-15-79 - 7-1-81, 29.5 mo.)
24	The fixed costs within the management arc of the network consist of the following, and are placed there for convenience of inclusion within the network (BCE Vol. I, p. 30, 31). Software (data, publications, drawings) $ 975,000 ED spares 168,000 Training 364,000 Test equipment 584,000 Total $2,091,000
25	Cost for contractual studies administered by the Army during Phase II as per BCE Vol. I, p. 32.

TABLE 2. (Sheet 4 of 4)

Note*	Comments
26	In-house studies cost estimate per BCE Vol. I, p. 32, 33

ECOM Pwr Pack - 2 m.y. x 42,500 + matl =	$ 100,000
ECOM Ant Dev - 4 m.y. x 42,500 + matl =	200,000
ECOM Comp Lab - 4.5 m.y. x 42,500 =	191,000
MICOM Arty Integ - 4.5 m.y. x 42,500 =	191,000
AVSCOM Acft Integ - 7 m.y. x 42,500 =	320,000
TACOM - 9 man years x 42,500 =	383,000
Transp. Cmd. - 5 man years x 42,500 + matl =	230,000
USAETL - 12 m.y. x 42,500 + matl	554,000
EW Labs - 4.5 m.y. x 42,500 =	191,000
AVSCOM Ant - 2 m.y. x 42,500 + matl =	100,000
ECOM Sys Anl - 4.7 m.y. x 42,500 =	200,000
Total	$2,660,000

c. An OR input rule requires that only one of the input arcs be successfully completed before the node is satisfied and its output arcs initiated.

2.2.2.2 Node Output Rules

Two of the three possible output rules available in SOLVNET were used in this analysis:

a. TERMINAL, a rule used to represent all possible completion points of the network. The node with a terminal ouput rule has no output arcs.

b. ALL, an output rule indicating that all output arcs will be simultaneously initiated when the input rule has been satisfied.

For any node with an AND or OR input rule and an ALL output rule, there is the possibility of initiating a default arc. In this analysis, a default arc is initiated following the failure of a Critical Design Review for a class of equipment. Default arcs are identified in Figure 1 as BRED, DRED, and ERED, which represent equipment redesign. Note that they follow the arcs BCDR, DCDR, and ECDR, respectively, where completion probabilities of less than 1.0 have been assigned.

2.2.3 Distribution of Arc Completion Times

The completion times of the arcs appearing in the network of Figure 1 were derived from 1) the schedule appearing in the previously referenced NAVSTAR GPS Baseline Cost Estimate, dated August 1976; and 2) scheduling information obtained from the JPO at SAMSO. These times are listed in Table 1 under "ARG-2", and represent the most likely of the triangularly distributed times. The "longest time", listed in Table 1 under ARG-3, is assumed to be 20% greater than ARG-2. The "shortest time" listed in Table 1 under ARG-1 is given as 10% less than ARG-2. It is felt that an assumed possible 20% slip in all arc completion times is a pessimistic representation of schedule risk for two reasons:

a. Not every arc represents an equally risky activity; some activities, in fact, have a highly predictable, controllable duration.

b. The design and test efforts conducted during Phase I will provide information which will substantially reduce risks caused by performance uncertainties or design surprises during Phase II.

2.2.4 Cost Allocation

Table 1 lists the cost allocated for the completion of each Army UE Phase II activity. Superscripts on these data refer to Table 2, which presents an explanation of where and how these costs were derived. In general, fixed costs are those associated with materials and hardware. Incremental (variable) costs are those associated with labor and salaries. Thus, increased arc durations may result in correspondingly increased labor costs.

2.2.5 SOLVNET Analysis

Attachment 1 is a reproduction of the computer printout resulting from exercising the SOLVNET program containing the data appearing in Table 1. The network was run for 1,000 iterations in a Monte Carlo analysis, with a point on each arc's triangular time distribution picked by random number generator for each iteration. The results are briefly summarized as follows:

a. The mean completion date for Army Phase II is 16 October 1981, with a standard deviation of 1.10 months. The mean cost is $36,192,000, with a standard deviation of $1,185,000. Figure 2 provides smoothed curves of the cost and time statistical plots appearing on the computer printouts in Attachment 1.

b. Arcs having a probability of greater than 5% of being part of the critical path of events during Phase II are listed in Table 3, along with their respective probabilities. Dummy arcs on the critical path are not included in the table. The first three arcs listed are combined Army and JPO activities, with no Phase II funding required from the Army. They are included in the network only for scheduling purposes, and have been modeled in this analysis as fixed-duration activities.

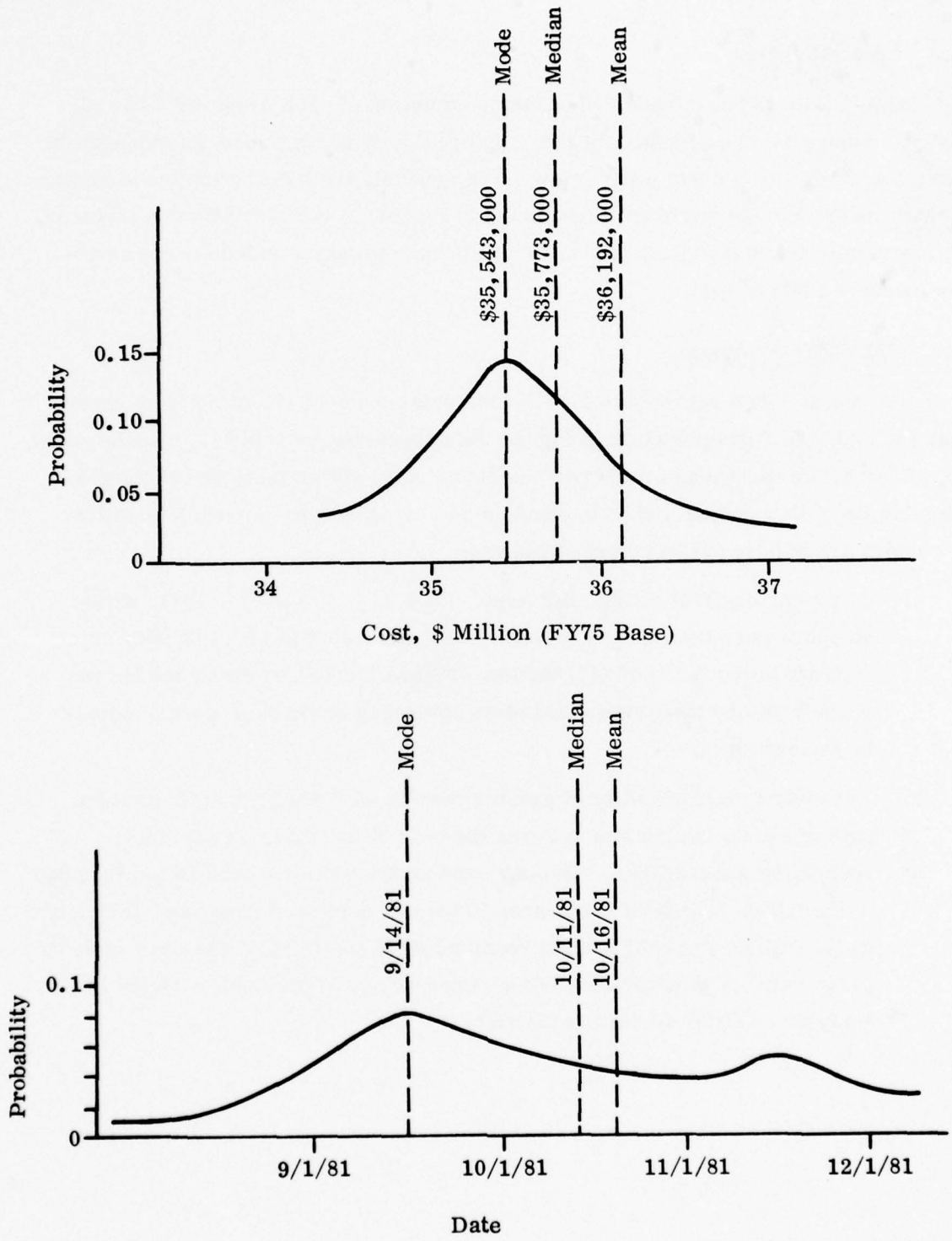


Figure 2. Smoothed Probability Plots of Army Phase II Cost and Completion Date

Attachment 1

ADVANCED SOLVNET COMPUTER PRINTOUT OF COST/SCHEDULE RISK ANALYSIS FOR ARMY USER EQUIPMENT, NAVSTAR GPS PHASE II

(The following excerpt from the Army publication, Advance SOLVNET, Report PAPAS-14, Rev. 2, describes the SOLVNET program output.)

PROGRAM OUTPUT

The printed output from SOLVNET provides statistical information on the expected duration, cost, and probability of success of the project under study.

A. Indices of Criticality

Indices of criticality are output for each arc. The index of criticality indicates how often the arc was on the critical path (e.g., an index of 0.8 means the arc was on the critical path for 80 percent of the iterations). Arcs with an index of 0 (never on critical path) are not listed.

B. Node Statistics

A set of node statistics is generated for internal nodes (optional), for each terminal node, and for all terminal nodes combined. Each set consists of three graphs.

1. Completion times (or dates) vs probability of occurrence (cumulative probability listed at left of graph)

2. Completion costs vs probability of occurrence (cumulative probability listed at left of graph)

3. Frequency of occurrence of cost-time pairs

The probability that the node was satisfied is printed for internal nodes and a graph indicating probability of network completion on each terminal node is printed.

C. Gap Statistics*

A set of Gap Statistics (optional) is generated for specific node pairs. Each set consists of two graphs:

1. Time differences (dating is not used) vs probability of occurrence (cumulative probability listed at left of graph).

2. Cost differences vs probability of occurrence (cumulative probability listed at left of graph).

*Gap Statistics were not generated for this network.

```
 IF YOU ARE RUNNING THIS FROM A TERMINAL
PLEASE ENTER A 1, IF RUNNING BATCH YOU SHOULD
HAVE ENTERED A CARD WITH A 0
FORMAT IS I1
0

THIS IS AN UPDATED VERSION OF SOLVNET
PLEASE NOTE CHANGES -
 1 - NETWORK DESCRIPTION (MODE A)
 2 - GRAPH DATING (MODE D)
 3 - INTERNAL AND GAP STATISTICS (MODE S)
 4 - USER DEFINED NODE HAS BEEN ADDED
 5 - 1/1 NODE HAS BEEN REMOVED
 6 - NEW SENSITIVITY ANALYSIS METHOD
PREVIOUS METHOD FOR ENTERING INTERNAL NODE
STATISTICS INDICATOR HAS BEEN CHANGED
SEE INSTRUCTIONS IN MODE S
FOR FURTHER INFORMATION CONTACT:
STEVE PEARCY - PICATINNY ARSENAL
AUTOVON 880-6721
•
2
DEGCIN11N001 2      4.750     4.750     4.750     0.000     0.000 1.000 S
•
DEGCN..1N002 2      1.250     1.250     1.250     0.000     0.000 1.000 S
•
PEPPIN12N003 2      4.250     4.250     4.250     0.000     0.000 1.000 S
•
0444N002N004 2      3.000     3.000     3.000     0.000     0.000 1.000 S
•
PPEVN003N005 2      6.000     6.000     6.000     0.000     0.000 1.000 S
•
APDPN004N106 2      1.800     2.000     2.400     0.000     0.000 1.000 S
•
BCDPN105N108 2      2.025     2.250     2.700     0.000      .279  .900 S
•
BPEPN106N109 2     10.350    11.500    13.800      .500      .279 1.000 S
•
BP2DN108N109 2      4.275     4.750     5.700     3.500      .279 1.000 S
•
BPEDN106N107 2      2.025     2.250     2.700     0.000      .419 1.000 S
•
BPDVN107N108 2      8.325     9.250    11.100      .500      .419 1.000 S
•
DABAN106N110 2      2.925     3.250     3.900     0.000     0.000 1.000 S
•
BKITN110N111 2      5.850     6.500     7.800      .125      .308 1.000 S
•
BKTSN111N112 2      5.850     6.500     7.800      .875      .308 1.000 S
•
DAEBN107N110 2       .900     1.000     1.200     0.000     0.000 1.000 S
•
DABCN106N113 2      2.025     2.250     2.700     0.000     0.000 1.000 S
•
BIMDN113N114 2      6.975     7.750     9.300     0.000     0.000 1.000 S
•
BINSN114N115 2      3.825     4.250     5.100      .110     0.000 1.000 S
•
BACIN115N116 2      4.500     5.000     6.000      .770     0.000 1.000 S
•
DABDN107N113 2      0.000     0.000     0.000     0.000     0.000 1.000 S
•
DABEN111N114 2       .225      .250      .300     0.000     0.000 1.000 S
•
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DABFN114N117 2      1.575     1.750     2.100     0.000     0.000 1.000 S
*
DABGN108N115 2      2.475     2.750     3.300     0.000     0.000 1.000 S
*
DABHN108N117 2       .225      .250      .300     0.000     0.000 1.000 S
*
BDTEN117N119 2      4.050     4.500     5.400    12.000     0.000 1.000 S
*
BDTEN118N119 2      8.100     9.000    10.800     5.000     0.000 1.000 S
*
DABJN115N118 2      1.800     2.000     2.400     0.000     0.000 1.000 S
*
DABKN109N116 2      2.700     3.000     3.600     0.000     0.000 1.000 S
*
DABLN112N116 2      2.700     3.000     3.600     0.000     0.000 1.000 S
*
DABMN116N119 2      5.400     6.000     7.200     0.000     0.000 1.000 S
*
DABNN119N220 2      0.000     0.000     0.000     0.000     0.000 1.000 S
*
DPDRN004N205 2      3.375     3.750     4.500     0.000     2.080 1.000 S
*
DCDRN205N206 2      2.250     2.500     3.000     0.000     2.586  .900 S
*
DREDN206N207 2      2.250     2.500     3.000     0.000     3.879 1.000 S
*
DRDVN207N208 2      9.000    10.000    12.000     .420      3.879 1.000 S
*
DPEPN206N208 2     11.250    12.500    15.000     .420      2.586 1.000 S
*
DPRDN208N209 2      4.275     4.750     5.700    6.300      .506 1.000 S
*
DKITN210N211 2      4.500     5.000     6.000     .563      1.412 1.000 S
*
DKTSN211N212 2      3.150     3.500     4.200    2.438      1.412 1.000 S
*
DINSN214N215 2      4.725     5.250     6.300     0.000     0.000 1.000 S
*
DVEHN215N216 2      2.700     3.000     3.600     0.000     0.000 1.000 S
*
DDTEN217N219 2      4.500     5.000     6.000    30.000     0.000 1.000 S
*
DDTEN218N219 2      4.500     5.000     6.000    15.000     0.000 1.000 S
*
EPDRN004N305 2      3.375     3.750     4.500     0.000     3.120 1.000 S
*
ECDRN305N306 2      2.250     2.500     3.000     0.000     3.626  .800 S
*
EREDN306N307 2      2.250     2.500     3.000     0.000     5.440 1.000 S
*
ERDVN307N308 2      9.000    10.000    12.000     .420      5.440 1.000 S
*
EPEPN306N308 2     11.250    12.500    15.000     .420      3.626 1.000 S
*
EPRDN308N309 2      4.250     4.750     5.700    2.940      .506 1.000 S
*
DADAN206N210 2      5.175     5.750     6.900     0.000     0.000 1.000 S
*
DADBN207N210 2      2.925     3.250     3.900     0.000     0.000 1.000 S
*
DADEN211N214 2      0.000     0.000     0.000     0.000     0.000 1.000 S
*
DADGN208N215 2      3.150     3.500     4.200     0.000     0.000 1.000 S
*
DADHN204N217 2       .675      .750      .900     0.000     0.000 1.000 S
*
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DAEHN308N217 2       .675      .750      .900     0.000     0.000 1.000 S
*
DADJN215N218 2      2.025     2.250     2.700     0.000     0.000 1.000 S
*
DADKN209N216 2      1.575     1.750     2.100     0.000     0.000 1.000 S
*
DADLN212N216 2      4.275     4.750     5.700     0.000     0.000 1.000 S
*
DAEKN309N219 2      5.400     6.000     7.200     0.000     0.000 1.000 S
*
DADMN216N219 2      3.825     4.250     5.100     0.000     0.000 1.000 S
*
DADNN219N220 2      0.000     0.000     0.000     0.000     0.000 1.000 S
*
FSALN004N220 2     26.550    29.500    35.990    15.725      .850 1.000 S
*
MGMTN004N220 2     26.550    29.500    35.990    20.910      .347 1.000 S
*
CSTUN004N220 2     26.550    29.500    35.990    31.460     0.000 1.000 S
*
ISTUN004N220 2     26.550    29.500    35.990    26.600     0.000 1.000 S
*
RETU         *     -0.000    -0.000    -0.000    -0.000    -0.000 *.000
*
YOU HAVE RETURNED TO MONITOR MODE
SELECT THE MODE YOU WISH TO GO INTO AS INDICATED BEFORE
*
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*
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IN1241
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N00111
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N00211
*
N00311
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N00411
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N10511
*
N10611    BRED
*
N10711
*
N10821
*
N10911
*
N11021
*
N11111
*
N11211
*
N11321
*
N11411
*
N11511
*
N11611
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N11711
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N11811
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N11911
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N20511
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N20611    DRED
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N20711
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N20821
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N30511
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N30611    ERED
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RETU**
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YOU HAVE RETURNED TO MONITOR MODE
SELECT THE MODE YOU WISH TO GO INTO AS INDICATED BEFORE
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YOU HAVE RETURNED TO MONITOR MODE
SELECT THE MODE YOU WISH TO GO INTO AS INDICATED BEFORE
*
6
ENTER A RUN IDENTIFIER OF 80 CHARACTERS OR LESS
PHASE II GPS COST RISK ANALYSIS USING ADVANCED SOLVNET.DOLLARS X 100000
*
YOU HAVE RETURNED TO MONITOR MODE
SELECT THE MODE YOU WISH TO GO INTO AS INDICATED BEFORE
*
0
ENTER NETWORK STARTING DATE MONTH/DAY/YEAR
ENTER TIME UNITS-1,DAYS-2,WEEKS-3,MONTHS-4,YEARS

FORMAT IS I2/I2/I2,1X,I1 E.G. 12/05/73 2
10/15/77     3
*
YOU HAVE RETURNED TO MONITOR MODE
SELECT THE MODE YOU WISH TO GO INTO AS INDICATED BEFORE
*
4
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ARC	INPUT NODE	OUTPUT NODE	TIME DIST	ARG1	ARG2	ARG3	COST		PROB		
UEDC	IN11	N001	2	4.75	4.75	4.75	0.00 +	0.00	1.000	S	1
UECC	N001	N002	2	1.25	1.25	1.25	0.00 +	0.00	1.000	S	2
RFPP	IN12	N003	2	4.25	4.25	4.25	0.00 +	0.00	1.000	S	3
DAAA	NC02	N003	2	3.00	3.00	3.00	0.00 +	0.00	1.000	S	4
PREV	N003	N004	2	6.00	6.00	6.00	0.00 +	0.00	1.000	S	5
BPDR	N004	N105	2	1.80	2.00	2.40	0.00 +	0.00	1.000	S	6
BCDR	N105	N106	2	2.03	2.25	2.70	0.00 +	.28	.900	S	7
BPEP	N106	N108	2	10.35	11.50	13.80	.50 +	.28	1.000	S	8
BPRO	N108	N109	2	4.28	4.75	5.70	3.50 +	.28	1.000	S	9
BRED	N106	N107	2	2.03	2.25	2.70	0.00 +	.42	1.000	S	10
BRDV	N107	N108	2	8.32	9.25	11.10	.50 +	.42	1.000	S	11
DABA	N106	N110	2	2.92	3.25	3.90	0.00 +	0.00	1.000	S	12
BKIT	N110	N111	2	5.85	6.50	7.80	.13 +	.31	1.000	S	13
BKTS	N111	N112	2	5.85	6.50	7.80	.88 +	.31	1.000	S	14
DABB	N107	N110	2	.90	1.00	1.20	0.00 +	0.00	1.000	S	15
DABC	N106	N113	2	2.03	2.25	2.70	0.00 +	0.00	1.000	S	16
BIMD	N113	N114	2	6.97	7.75	9.30	0.00 +	0.00	1.000	S	17
BINS	N114	N115	2	3.83	4.25	5.10	.11 +	0.00	1.000	S	18
BACI	N115	N116	2	4.50	5.00	6.00	.77 +	0.00	1.000	S	19
DABD	N107	N113	2	0.00	0.00	0.00	0.00 +	0.00	1.000	S	20
DABE	N111	N114	2	.22	.25	.30	0.00 +	0.00	1.000	S	21
DABF	N114	N117	2	1.58	1.75	2.10	0.00 +	0.00	1.000	S	22
DABG	N108	N115	2	2.47	2.75	3.30	0.00 +	0.00	1.000	S	23
DABH	N109	N117	2	.22	.25	.30	0.00 +	0.00	1.000	S	24
BDTE	N117	N118	2	4.05	4.50	5.40	12.00 +	0.00	1.000	S	25
BOTE	N118	N119	2	8.10	9.00	10.80	5.00 +	0.00	1.000	S	26
DABJ	N115	N118	2	1.80	2.00	2.40	0.00 +	0.00	1.000	S	27
DABK	N109	N116	2	2.70	3.00	3.60	0.00 +	0.00	1.000	S	28
DABL	N112	N116	2	2.70	3.00	3.60	0.00 +	0.00	1.000	S	29
DABM	N116	N119	2	5.40	6.00	7.20	0.00 +	0.00	1.000	S	30
DABN	N119	N220	2	0.00	0.00	0.00	0.00 +	0.00	1.000	S	31
DPDR	N004	N205	2	3.38	3.75	4.50	0.00 +	2.08	1.000	S	32
DCDR	N205	N206	2	2.25	2.50	3.00	0.00 +	2.59	.900	S	33
DRED	N206	N207	2	2.25	2.50	3.00	0.00 +	3.88	1.000	S	34
DRDV	N207	N208	2	9.00	10.00	12.00	.42 +	3.88	1.000	S	35
DPEP	N206	N208	2	11.25	12.50	15.00	.42 +	2.59	1.000	S	36
DPRO	N208	N209	2	4.28	4.75	5.70	6.30 +	.51	1.000	S	37
DKIT	N210	N211	2	4.50	5.00	6.00	.56 +	1.41	1.000	S	38
DKTS	N211	N212	2	3.15	3.50	4.20	2.44 +	1.41	1.000	S	39
DINS	N214	N215	2	4.72	5.25	6.30	0.00 +	0.00	1.000	S	40
DVEH	N215	N216	2	2.70	3.00	3.60	0.00 +	0.00	1.000	S	41
DDTE	N217	N218	2	4.50	5.00	6.00	30.00 +	0.00	1.000	S	42
DOTE	N218	N219	2	4.50	5.00	6.00	15.00 +	0.00	1.000	S	43
EPDR	N004	N305	2	3.38	3.75	4.50	0.00 +	3.12	1.000	S	44
ECDR	N305	N306	2	2.25	2.50	3.00	0.00 +	3.63	.800	S	45
ERED	N306	N307	2	2.25	2.50	3.00	0.00 +	5.44	1.000	S	46
ERDV	N307	N308	2	9.00	10.00	12.00	.42 +	5.44	1.000	S	47
EPEP	N306	N308	2	11.25	12.50	15.00	.42 +	3.63	1.000	S	48
EPRO	N308	N309	2	4.25	4.75	5.70	2.94 +	.51	1.000	S	49
DADA	N206	N210	2	5.18	5.75	6.90	0.00 +	0.00	1.000	S	50
DADB	N207	N210	2	2.92	3.25	3.90	0.00 +	0.00	1.000	S	51
DADE	N211	N214	2	0.00	0.00	0.00	0.00 +	0.00	1.000	S	52
DADG	N208	N215	2	3.15	3.50	4.20	0.00 +	0.00	1.000	S	53
DADH	N208	N217	2	.68	.75	.90	0.00 +	0.00	1.000	S	54
DAEH	N308	N217	2	.68	.75	.90	0.00 +	0.00	1.000	S	55
DADJ	N215	N218	2	2.03	2.25	2.70	0.00 +	0.00	1.000	S	56
DADK	N209	N216	2	1.58	1.75	2.10	0.00 +	0.00	1.000	S	57
DADL	N217	N216	2	4.28	4.75	5.70	0.00 +	0.00	1.000	S	58
DAEK	N309	N219	2	5.40	6.00	7.20	0.00 +	0.00	1.000	S	59
DADM	N216	N219	2	3.83	4.25	5.10	0.00 +	0.00	1.000	S	60
DADN	N219	N220	2	0.00	0.00	0.00	0.00 +	0.00	1.000	S	61
FSAL	N004	N220	2	26.55	29.50	35.99	15.73 +	.85	1.000	S	62
MGMT	N004	N220	2	26.55	29.50	35.99	20.91 +	.35	1.000	S	63
CSTU	N004	N220	2	26.55	29.50	35.99	31.46 +	0.00	1.000	S	64
ISTU	N004	N220	2	26.55	29.50	35.99	26.60 +	0.00	1.000	S	65

NODE	NO. OF INPUT ARCS	NO. OF OUTPUT ARCS	INPUT TYPE	OUTPUT TYPE	
IN11	0	1	4	1	1
N001	1	1	1	1	2
N002	1	1	1	1	3
IN12	0	1	4	1	4
N003	2	1	1	1	5
N004	1	7	1	1	6
N105	1	1	1	1	7
N106	1	4	1	1	8
N108	2	3	2	1	9
N109	1	1	1	1	10
N107	1	3	1	1	11
N110	2	1	2	1	12
N111	1	2	1	1	13
N112	1	1	1	1	14
N113	2	1	2	1	15
N114	2	2	1	1	16
N115	2	2	1	1	17
N116	3	1	1	1	18
N117	2	1	1	1	19
N118	2	1	1	1	20
N119	2	1	1	1	21
N220	6	0	1	4	22
N205	1	1	1	1	23
N206	1	3	1	1	24
N207	1	2	1	1	25
N208	2	3	2	1	26
N209	1	1	1	1	27
N210	2	1	2	1	28
N211	1	2	1	1	29
N212	1	1	1	1	30
N214	1	1	1	1	31
N215	2	2	1	1	32
N216	3	1	1	1	33
N217	2	1	1	1	34
N218	2	1	1	1	35
N219	3	1	1	1	36
N305	1	1	1	1	37
N306	1	2	1	1	38
N307	1	1	1	1	39
N308	2	2	2	1	40
N309	1	1	1	1	41

•

YOU HAVE RETURNED TO MONITOR MODE
SELECT THE MODE YOU WISH TO GO INTO AS INDICATED BEFORE

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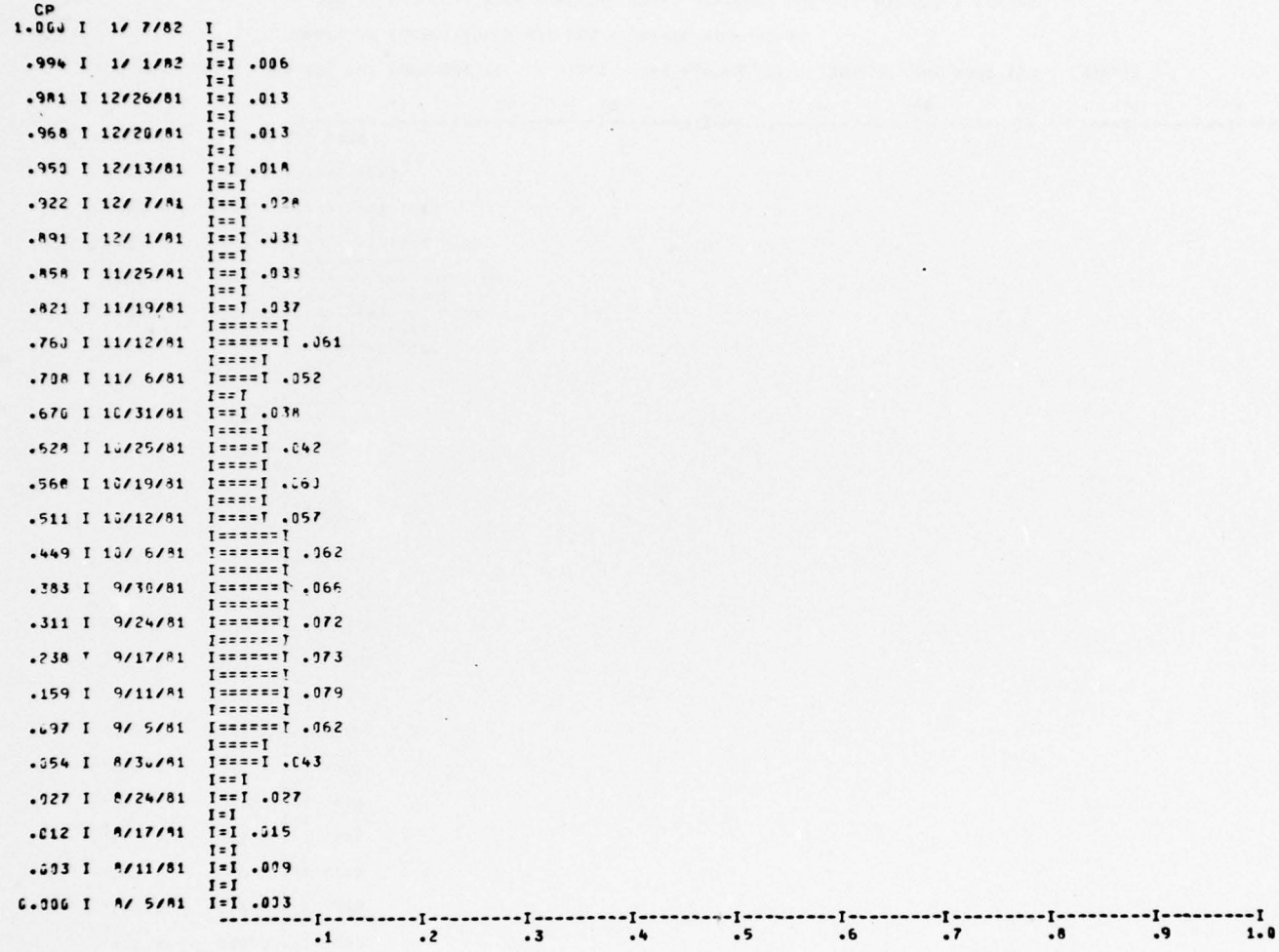
CRITICAL PATH INDICES

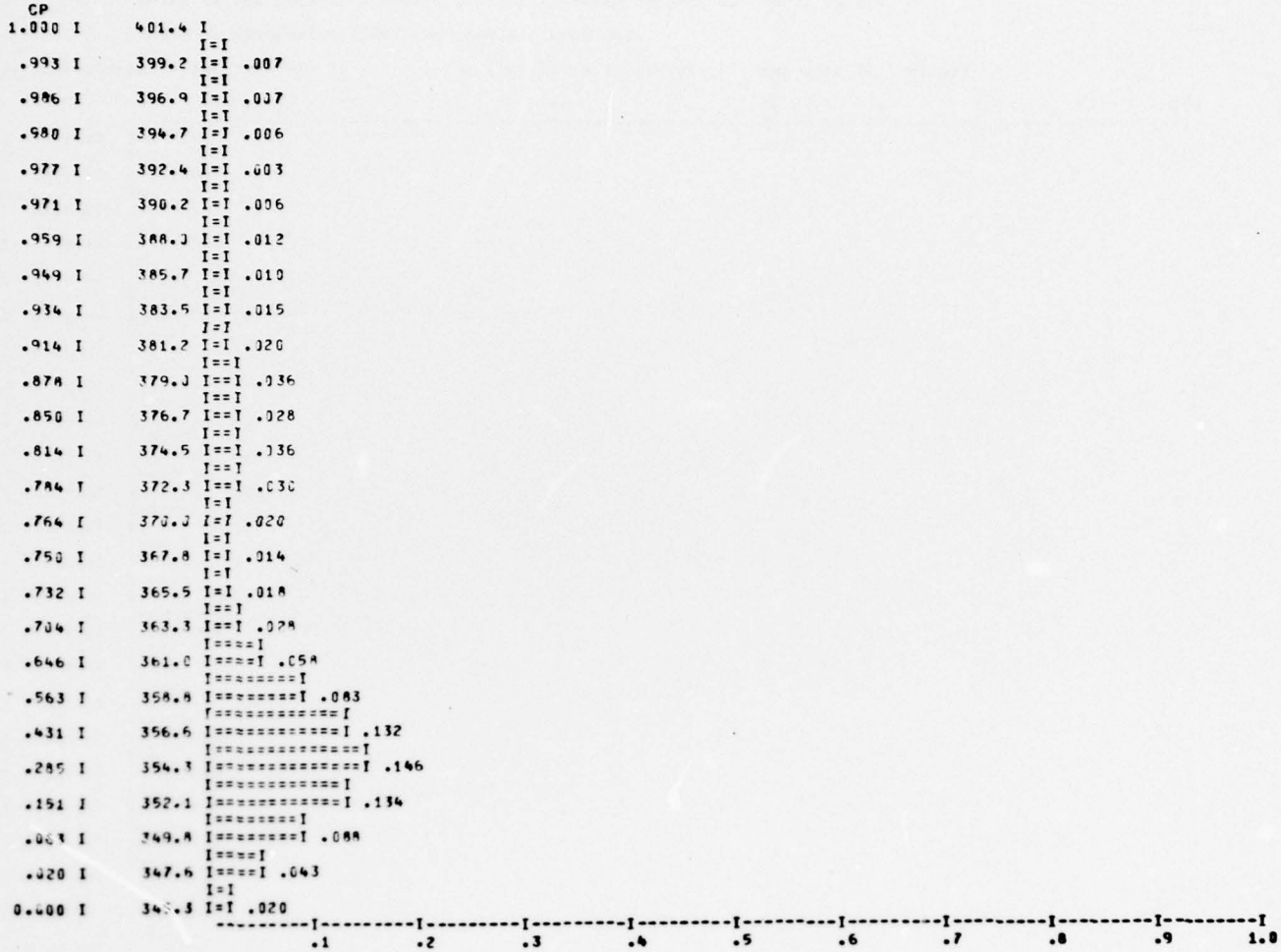
ARC	INDEX OF CRITICALITY
UEDC	1.000
UECC	1.000
DAAA	1.000
PREV	1.000
BPDR	.144
BCDR	.144
BPEP	.068
BPRO	.019
BPEO	.014
BRDV	.006
DABA	.038
BKIT	.043
BKTS	.016
DABB	.005
DABC	.024
BIMD	.027
BINS	.040
BACI	.033
DABD	.003
DABE	.027
DABF	.014
DABG	.030
DABH	.025
BOTE	.039
BOTE	.076
DABJ	.037
DABK	.019
DABL	.016
DABM	.068
DABN	.144
DPDR	.095
DCDR	.095
DRED	.008
DRDV	.003
DPEP	.057
DPRO	.013
DKIT	.035
DKTS	.013
DINS	.022
DVEH	.028
DOTE	.045
DOTE	.069
EPDR	.063
ECDR	.063
ERED	.012
ERDV	.012
EPEP	.051
EPRO	.035
DADA	.030
DADB	.005
DADE	.022
DADG	.030
DADH	.017
DAEH	.028
DADJ	.024
DADK	.013
DADL	.013
DAEK	.035
DADM	.054
DADN	.158
FSAL	.166
MGMT	.183
CSTU	.180
ISTU	.169



THE MEAN IS 10/16/81 THE STAN DEV IS 1.10 THE MEDIAN IS 10/11/81 THE MODE IS 9/14/81

GRAPH OF COMPLETION TIMES FOR TERMINAL NODE N220

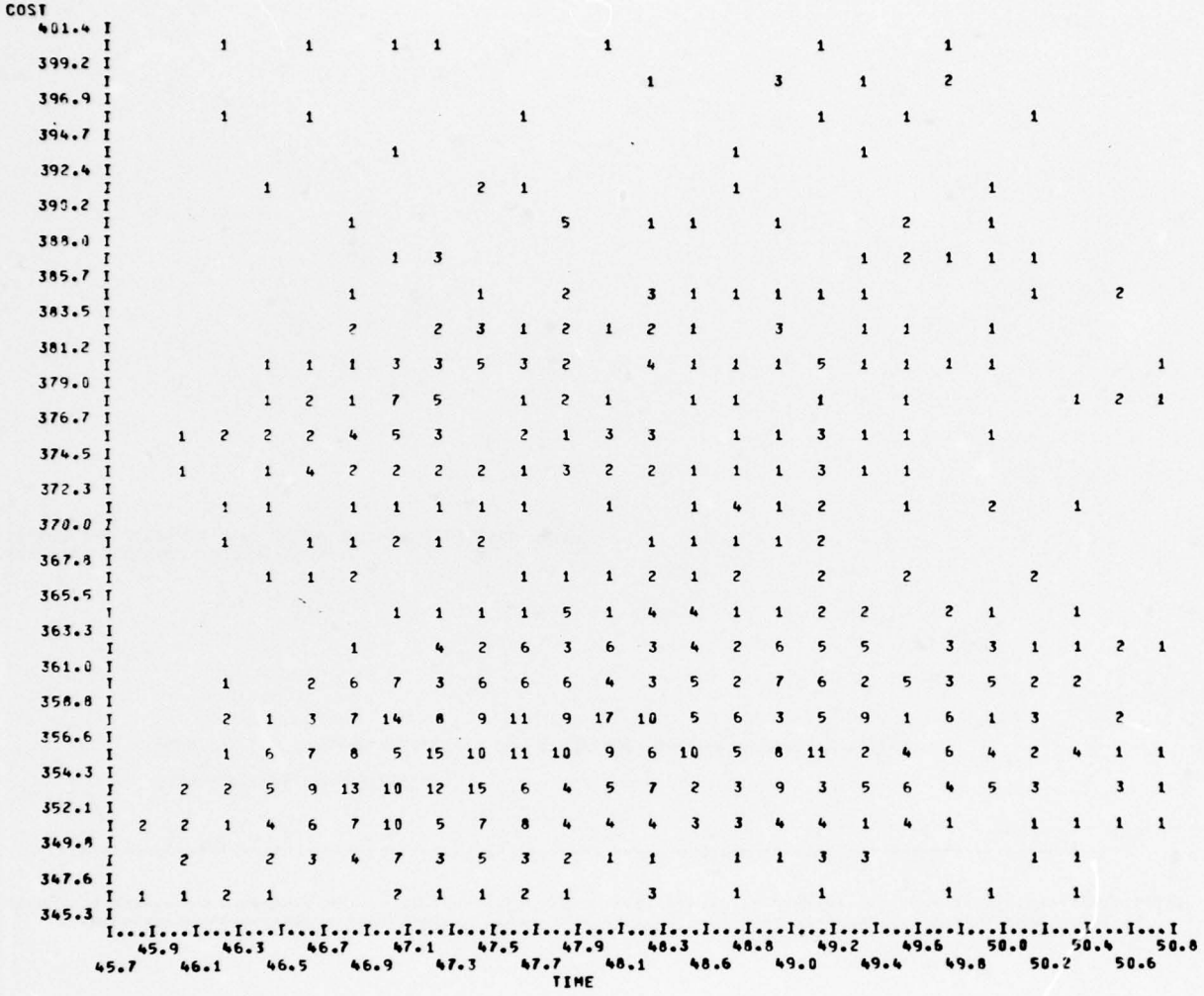
PHASE II GPS COST RISK ANALYSIS USING ADVANCED SOLVNET.DOLLARS X 100000



THE MEAN IS 361.92 THE STAN DEV IS 11.85 THE MEDIAN IS 357.73 THE MODE IS 355.43

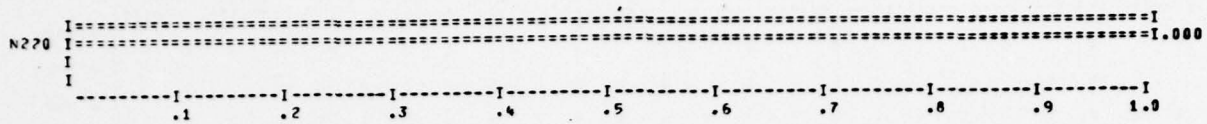
GRAPH OF COMPLETION COSTS FOR TERMINAL NODE N220

PHASE II GPS COST RISK ANALYSIS USING ADVANCED SOLVNET.DOLLARS X 100000



BIVARIATE GRAPH FOR TERMINAL NODE N220

PHASE II GPS COST RISK ANALYSIS USING ADVANCED SOLVNET.DOLLARS X 100000



GRAPH OF NODE PROBABILITIES

PHASE II SPS COST RISK ANALYSIS USING ADVANCED SOLVNET.DOLLARS X 100000

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YOU HAVE RETURNED TO MONITOR MODE
SELECT THE MODE YOU WISH TO GO INTO AS INDICATED BEFORE
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TABLE 3. CRITICAL PATH ARCS

Arc Name	Description	Probability of Being on Critical Path
UEDC	UE Design Consolidation	1.00
UECC	UE Consolidation Finalization	1.00
PREV	Proposal Evaluation	1.00
BPDR	Development Engineering, B Set	0.144
BCDR	PEP/Development Engineering, B Set	0.144
BPEP	PEP/Prototype Development, B Set	0.068
BOTE	Op. Testing, Integrated B Set	0.076
DPDR	Development Engineering, D Set	0.095
DCDR	PEP/Development Engineering, D Set	0.095
DPEP	PEP/Prototype Development, D Set	0.057
DOTE	Op. Testing, D and E Sets	0.069
EPDR	Development Engineering, E Set	0.063
ECDR	PEP/Development Engineering, E Set	0.063
EPEP	PEP/Prototype Development, E Set	0.051
FSAL	GPS Field Office Activities	0.166
MGMT	Contractor Systems Management	0.183
CSTU	Contractual Studies	0.180
ISTU	In-House Studies	0.169

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